**Photosynthesis and Cellular Respiration**

**8th grade/Biology**

**Introduction:**

The overall goal for this lesson is to familiarize students with the basics of photosynthesis and cellular respiration through investigations and the connections between the two processes. Students should want to learn this because it is an integral part of their survival (food source and oxygen) as well as their future (solar power).

**Objectives:**

* describe the process of gas exchange in plants
* explain the process and importance of photosynthesis
* describe the process and importance of respiration and its relationship to photosynthesis
* excel at working in group situations

**Florida Sunshine State Standards:**

* SC.8.L.18.1: Describe and investigate the process of photosynthesis, such as the roles of light, carbon dioxide, water and chlorophyll; production of food; release of oxygen.
* SC.8.L.18.2: Describe and investigate how cellular respiration breaks down food to provide energy and releases carbon dioxide.

**National Science Education Standards:**

* Systems, order, and organization
* Abilities necessary to do scientific inquiry
* Structure and function in living systems
* Science as a human endeavor
* Nature of science
* History of science
* Evidence, models, and explanation
* Change, constancy, and measurement
* Form and function

**Materials:**

baking soda, beakers, elodea sprigs, glass funnels, test tubes, metric rulers, peace lily or pothos leaves, clear plastic cups, cardboard, rocks, food coloring, petroleum jelly, cotton balls, scissors, plant leaves, clear fingernail polish, clear cellophane tape, microscopes, slides, dry yeast, soda bottles, flexible tape measure, balloons, sugar, masking tape, thermometers

**Internet/WWW resources:**

* photosynthesis song-[www.rrojas.com/home/rojassongs/photosynthesissong](file:///C:\Users\Crystal\AppData\Roaming\Microsoft\Word\www.rrojas.com\home\rojassongs\photosynthesissong)
* photosynthesis video- <http://www.teachersdomain.org/resource/tdc02.sci.life.stru.photosynth/>
* stomata lab-www.biologycorner.com/worksheets/stomata.html
* respiration yeast lab-www.science-class.net/Biology/Photosynthesis.htm
* lab performance rubric-www.docstoc.com/docs/19501565/Lab-Rubric

**Possible Hazards/Safety Considerations:**

* review proper handling of glassware and microscopes

**Procedures:**

**Day 1**

1. Have the **photosynthesis song** playing as students enter the classroom. ([www.rrojas.com/home/rojassongs/photosynthesissong](file:///C:\Users\Crystal\AppData\Roaming\Microsoft\Word\www.rrojas.com\home\rojassongs\photosynthesissong))

2. Turn off the song.

3. Hand out the **KW**L worksheet and have the students complete the "what I know" and "what I want to know" columns. Collect the worksheets. Then have students share what they wrote and as a class come up with a definition for photosynthesis. Write this down so students can modify/change their definition at the end of the lesson if necessary.

\*Review the KWL worksheets and offer extra credit to the individuals who listed things under "what I want to know" that will not be covered in class. This can be submitted in a variety of forms as long as the student provides a well researched answer to their question.

4. Separate students into appropriate groups and have them set up the **Measuring the Rate of Photosynthesis Lab**.

\*Protocols for all lab/group assignments: All students will be given a Lab Performance Rubric at the beginning of the year to read over and sign. Create a list of student names for each class and during labs give them a check whenever a lab violation occurs. Each check is worth one point and will be subtracted from their final lab grade. Lab/group behavior is worth 10% of their grade. Group participation is determined anonymously by the averages of scores received from other group members. Students will rate each group member individually on a scale from 1 to 5, 5 being the best. It is important to take the time to explain to students what each number might look like or allow them to discuss as a class what they think each number should represent. Make a copy of this for reference. Then the average of these scores will be calculated and multiplied by 6, accounting for 30% of the final lab grade. All students should have a record of the lab information in their science journals but only one paper per group needs to be turned in for a grade. The handed in portion of the lab accounts for the remaining 60%.

\*Take pictures of your junior scientists at work.

**Day 2**

\***Transpiration Lab** needs to be set up the day before but keep it covered or hidden until you are ready to describe it.

1. Groups should record photosynthesis lab data for day 1.

2. Have students close their eyes and ask them to raise their hands if they think plants sweat. Record the number on the board. Discuss their answers.

3. Present and describe the experiment you set up. Allow students to get up close and make observations. Guide students to define transpiration and to determine that the underside of the leaf is a key component.

4. Have students do the **Stomata Lab** in groups.

**Day 3**

1. Groups should record photosynthesis lab data for day 2.

2. Explain to students that they are going to work in groups to create a **photosynthesis play**.

3. Play **photosynthesis video** (<http://www.teachersdomain.org/resource/tdc02.sci.life.stru.photosynth/>). Have students take notes and replay the video if necessary. Review/revise the class definition of photosynthesis.

4. Give students the skit/play rubric so they know what to include in their play and allow them the rest of the class period to work on it. Write the following terms on the board and require that they are included in the play (this should fall under content on the rubric): photosynthesis, stomata, guard cells, transpiration, chlorophyll, chloroplasts, oxygen, carbon dioxide, water, sugar, glucose, food, energy, and light

**Day 4**

1. Groups should record photosynthesis lab data for day 3.

2. Ask students, "Where does the carbon dioxide come from that plants need for photosynthesis?" Define cellular respiration.

3. Have groups conduct the **Respiration Yeast Lab**

**Day 5**

1. Give back KW**L** and have students complete the L column (what they learned) using the following terms: respiration, mitochondria, photosynthesis, stomata, guard cells, transpiration, chlorophyll, chloroplasts, oxygen, carbon dioxide, water, sugar, glucose, food, energy, and light

2. Complete photosynthesis lab (disregard day 5) and work on photosynthesis play. Offer extra credit to groups that incorporate cellular respiration into their play.

**Day 6**

1. Have groups present plays and video tape if possible.

**Assessment:**

The L part of the KWL, their science journals and the play can be used to alternatively assess the students' knowledge. These two things along with the labs should provide valuable information for future teaching as to whether the desired learning outcomes/objectives were achieved.

**Teaching Strategies:**

* laboratory work
* group work
* audio-visuals
* audio
* act it out
* KWL
* alternative assessment

**Technology Use:**

* internet for researching the play
* excel for graphing lab results
* use of microscopes
* use of thermometers

**Questioning Techniques:**

* use a variety of types of questions during discussions and lectures, on assignments and assessments: Factual; Convergent; Divergent; Evaluative; and Combination
* use all levels of bloom's taxonomy; an example of higher order thinking can be seen in the rate of photosynthesis lab question #5(application) and "further inquiry"(synthesis)

**Interdisciplinary Connections:**

* chemistry because photosynthesis and cellular respiration are chemical processes
* English because of the journal writing and play composing
* history because people initially thought plants ate dirt
* math because of the graphing required

**Possible Outside Resources:**

A field trip could be as simple as a walk around campus to observe plants and collect leaves. A possible guest speaker could come from a local nursery. Families could be involved by having students do an at home experiment. The transpiration experiment could be an at home project or students could be encouraged to create their own experiment to conduct with their family and share with the class. Possible extension activities would be to elaborate on the labs conducted by having students pose questions. For example, what would happen in the rate of photosynthesis lab if the container was placed in the dark?

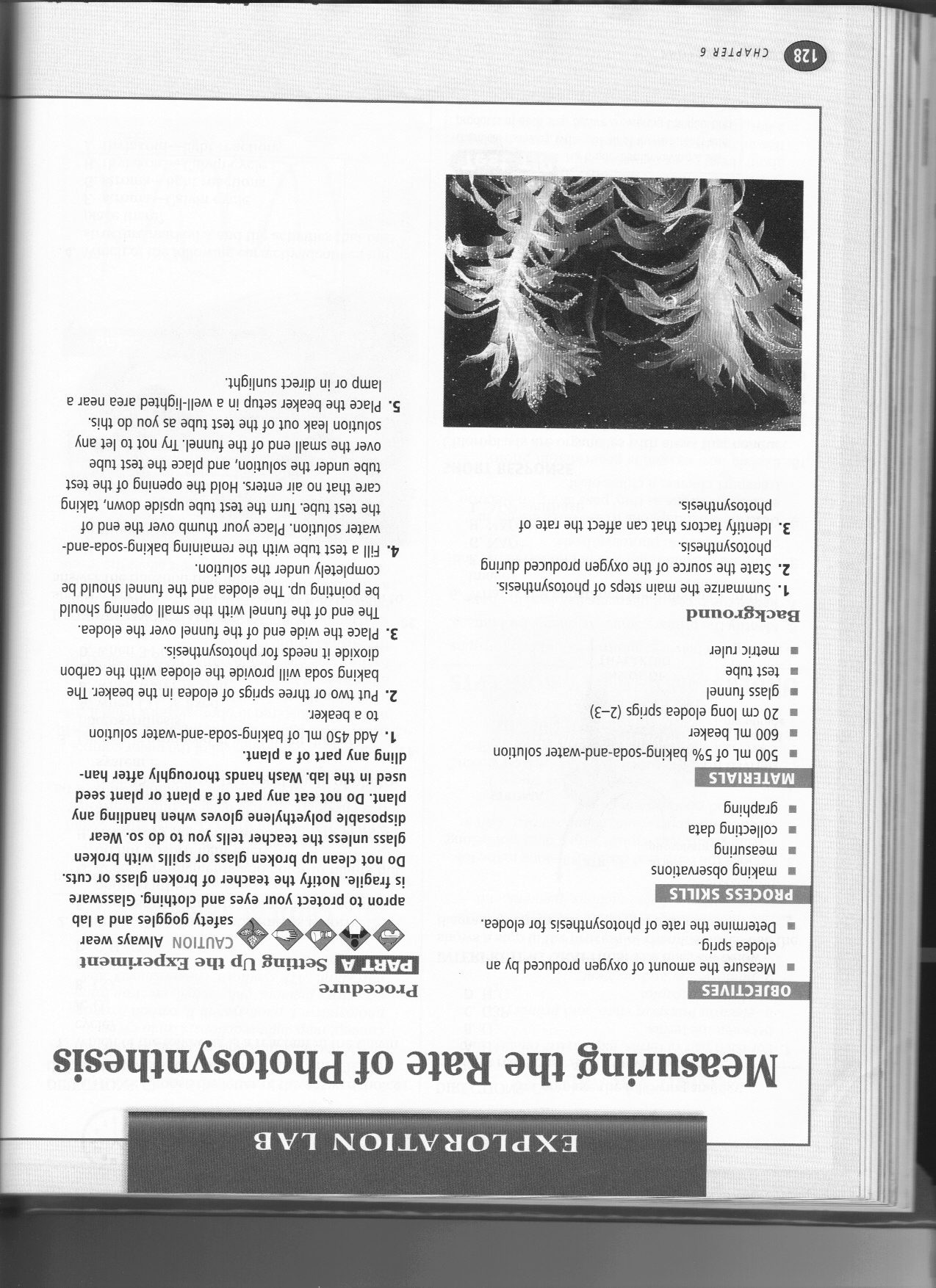
Photosynthesis KWL Handout

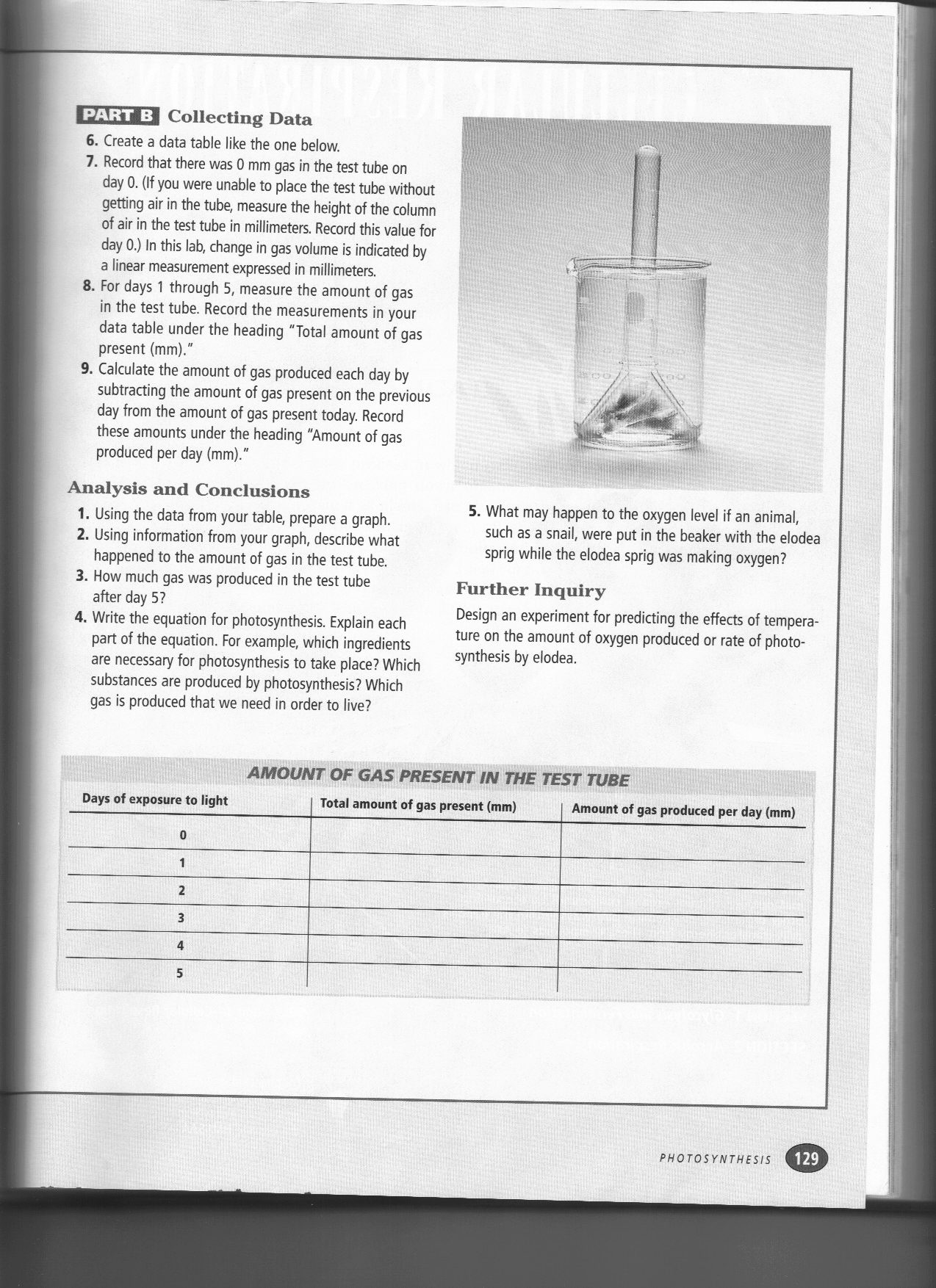
Purpose: This thinking strategy is used with text and provides the framework for constructing meaning. The KWL consists of three parts: 1) prior to learning, identify what readers KNOW about a topic; 2) prior to learning, determine what readers WANT to find out about the topic, and 3) after the learning experience, note what readers LEARNED about the topic.

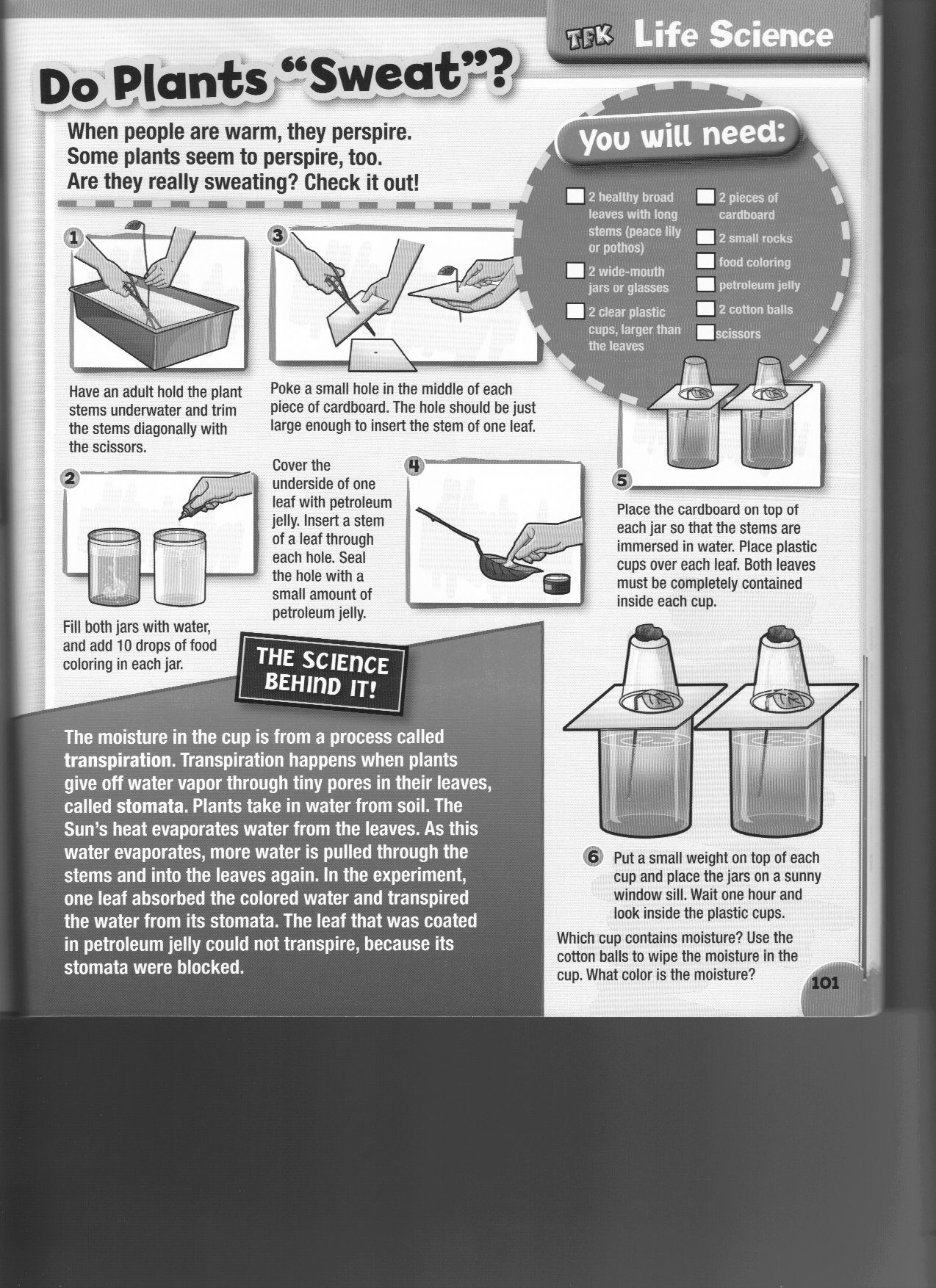
|  |  |  |
| --- | --- | --- |
| **KWL Chart** | | |
| **Photosynthesis** | | |
| **What I Know** | **What I Want to Know** | **What I Learned** |
|  |  |  |

|  |  |  |
| --- | --- | --- |
| **Category** | **Lab Performance Rubric**  **Meeting Standard** | **Below Standard** |
| **Time Management** | 1. I get started quickly 2. I know how much time I have for each activity 3. I pace myself so I can finish before time runs out | 1. I take a long time to get started 2. I start rushing at the last minute so I can finish 3. I’m surprised or not finished when time runs out |
| **Group Work** | 1. I divide the work fairly with my partners 2. I do my fair share of the work, and do it well 3. I talk to others with respect and use quiet voices 4. We only talk about the lab, at appropriate volume | 1. I let one person do most of the work 2. I rely on others to make sure we did a good job 3. I say whatever I think, regardless of how it makes others feel 4. I talk loudly or talk about non-lab topics |
| **Materials** | 1. I make sure we have all the materials we need 2. I use lab materials only as directed 3. I keep track of materials during lab, and don’t let them fall on the floor or get damaged 4. I report any damaged or missing materials to teacher 5. I make sure we return all of our materials at the end of class 6. I follow directions for waste disposal | 1. I wait for other people to give me materials 2. I play with lab materials or misuse them 3. I only pay attention to the materials when I’m using them, and sometimes they fall on the floor or get damaged 4. I hope no one notices when materials are missing or broken 5. I expect others to clean up my group’s materials 6. I put waste in the trash or sink no matter what the teacher says to do |
| **Seating/Movement** | 1. I stay in my seat unless I’m expected to get up for a specific lab-related reason 2. When I’m out of my seat, I take care of my lab-related business and sit down again right away 3. I don’t run, chase, dance, or make other dangerous movements | 1. I get out of my seat whenever I feel like it 2. When I’m out of my seat, I wander around and look for something to do 3. I sometimes chase others, run, or play around while I’m out of my seat |
| **Safety** | 1. I wear goggles and other safety equipment when told to 2. I keep my goggles on until told to remove them 3. I tell the teacher when an accident or spill occurs 4. I clean up after my group | 1. I don’t wear safety equipment if I don’t feel like it 2. I take my goggles off if I feel like it 3. I don’t do anything about spills and accidents 4. I expect others to clean up after my group’s messes |
| **Directions** | 1. I always listen to and read the directions carefully 2. I ask a question if I don’t know what to do 3. I follow directions exactly, and make sure my group is doing things correctly 4. I use only the correct amount of materials, so there is enough for other classes | 1. I just assume I know what to do, so I don’t listen 2. If I don’t know what to do, I whine (“I don’t get it!”) or just sit there doing nothing 3. I change the directions if I feel like it, and let others in my group play around 4. I sometimes waste materials |
| **Written Work** | 1. I know what I’m supposed to turn in and when it’s due 2. I turn in work as directed 3. I record data and observations during lab | 1. I don’t know what the written assignment is 2. I leave my paper on the floor, on my desk, or in my binder 3. I don’t record my data during lab, and then I try to remember what happened |

Lab Performance Rubric







Investigation of Leaf Stomata

Materials: Plant leaves, Clear fingernail polish, Clear cellophane tape (clear package sealing tape), Microscope Microscope slides

Procedure:

1. Obtain a study leaf or other plant tissue.  
2. Paint a thick patch of clear nail polish on the leaf surface being studied. Make a patch at least one square centimeter.  
3. Allow the nail polish to dry completely.   
4. Tape a piece of clear cellophane tape to the dried nail polish patch. (The tape must be clear. Do not use Scotch® tape or any other opaque tape. Clear carton-sealing tape works well.)   
5. Gently peel the nail polish patch from the leaf by pulling on a corner of the tape and "peeling" the fingernail polish off the leaf. This is the leaf impression you will examine. (Only make one leaf impression on each side of the leaf, especially if the leaf is going to be left on a live plant.)   
6. Tape your peeled impression to a very clean microscope slide. Use scissors to trim away any excess tape.

**Introduction:**

Scan the slide until you find a good area where you can see the stomata. Each stoma is bordered by two sausage-shaped cells that are usually smaller than surrounding epidermal cells. These small cells are called guard cells and, unlike other cells in the epidermis, contain chloroplasts.

1. Sketch. Label the Stoma, Guard Cells, Epidermal Cells, and Chloroplasts

2. Estimate the number of stomata on your sample.

**Experiment:**

Guard cells are responsible for opening and closing the stoma. When water concentration is high, the guard cells will bulge, and cause the stoma to open. When the water concentration is low, the stoma will close. Stoma are generally open when plants are photosynthesizing.

Question: Will plants have more stoma open during the day than during the night?

3. Make a hypothesis about the number of open stomata found in a plant kept in the dark compared to a plant in the light.

Repeat the procedure above for preparing your slide. You will make two impressions, one from a "Dark Plant" and one from a "Light Plant" You will compare the two impressions.

4. Data Table:

|  |  |
| --- | --- |
| Plant | Number of Stomata |
| Light |  |
| Dark |  |

5. Conclusions: Write a short paragraph that answers the question; use your data to support your conclusions. (Question: Will plants have more stoma open during the day than during the night?)

